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PROCEEDINGS OF A CONFERENCE
ON
**THE ECONOMICS OF HIGHWAY
TRANSPORT**
CALLED BY THE
HIGHWAY AND HIGHWAY TRANSPORT
EDUCATION COMMITTEE
HELD AT THE
UNIVERSITY OF MARYLAND, COLLEGE PARK
JULY 27, 1921

EDITED BY C. J. TILDEN

PRICE, 50 CENTS

Published by the
Highway and Highway Transport Education Committee
Washington, D. C.
1922

THE HIGHWAY AND HIGHWAY TRANSPORT EDUCATION COMMITTEE

Willard Building, Washington, D. C.

Appointed May 28, 1920, by Dr. P. P. Claxton, Commissioner of Education,
and First Chairman of the Committee.

JOHN J. TIGERT, U. S. Commissioner of Education, Chairman after August 8,
1921.

THOMAS H. MACDONALD, Chief of the Bureau of Public Roads, U. S. Department
of Agriculture.

F. C. BOGGS, Colonel, Corps of Engineers, U. S. Army, representing the War
Department.

Roy D. CHAPIN, President, Hudson Motor Car Company, representing the
National Automobile Chamber of Commerce.

HARVEY S. FIRESTONE, President, Firestone Tire and Rubber Company, repre-
senting the Rubber Association of America.

F. L. BISHOP, Dean of Engineering, University of Pittsburgh, representing
the Society for the Promotion of Engineering Education.

W. S. KELLER, State Highway Engineer of Alabama, representing the American
Association of State Highway Officials.

C. J. TILDEN, Director.

Conference on highway engineering and
highway transport education (Regional)
University of Maryland, July 27 1921

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Program

The Economics of Highway Transport

A Conference called by the Highway and Highway Transport Education Committee for July 27, 1921

Object

The purpose of the conference is to define the chief economic problems underlying the building and use of our highways, and suggest topics for college courses, both graduate and undergraduate, in highway and highway transport economics.

10 a. m. Meet at Bureau of Public Roads, Willard Building, Washington, and take automobiles for the University of Maryland, College Park.

11 a. m. First session:

Greeting from President Woods.

Chairman of the Conference, President Charles S. Howe, Case School of Applied Science, Cleveland.

Topics: Highway Transport (pp. 6-14).

Highway Finance (pp. 14-17).

Economic Problems of Construction and Maintenance (pp. 18-20).

1 p. m. Luncheon. Those attending the Conference are guests of the University of Maryland.

2.20 p. m. Second Session:

Highway Administration (pp. 24-28).

Cost Accounting in Highway Transport Operation (pp. 29-33).

National and State Legislation (pp. 33-41).

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Conference on The Economics of Highway Transport

THE Conference was called to order by Professor C. J. Tilden, Director of the Committee, who said:

The Highway and Highway Transport Education Committee has called this conference for the purpose of getting your advice and help. The rapid development of motor transport, with increased production of motor vehicles and consequent stimulation of public interest in highways, has raised economic questions difficult to answer. Many of these have not as yet even been clearly formulated. Technical schools have surprisingly few courses bearing on the subject, although it is of vital concern to every citizen.

We have asked you, therefore, to come together as representatives of various interests—industrial, governmental, municipal and university—to exchange views and, through discussion, indicate the direction in which educational activity may be started. In the letter of invitation it was suggested that the conference was not to be controversial in any way. It is hoped that suggestions may be made regarding the topics of undergraduate and graduate courses, questions for research, etc.

We are particularly fortunate in being guests of the University of Maryland on this occasion. President Woods and Dean Johnson have been especially active in arranging for our comfort here, and I am going to ask President Woods if he will give us a word of greeting.

PRESIDENT WOODS: I am very glad indeed for the opportunity of welcoming you here, because highway engineering has for many years been a subject of very great interest in Maryland, especially the work that is being done in the state in the practical application of engineering research to highway construction and use. The University of Maryland is intensely interested in this work and desires to promote it in every way. The old idea that an engineering department could teach what it wanted to, in the way it wanted to, regardless of the application to the problems to be solved in the industries, has been done away with. To study these problems in the way you are attacking them today has evidently established a new viewpoint in relation to industrial education. We must analyze our problems, find out what our engineers need to know in order to solve them, and see that the necessary training is given. This will not be too narrow and specialized. We are trying to find out just what this training should be. We are going to take the recommendations and suggestions you make and put them in operation as far as our finances will permit. We want to assure you that not only are you welcome here but your suggestions are welcome in our curriculum. We will try to carry out in our educational processes the things you determine are necessary to train men in the way you want them trained. Please make yourselves at home.

Dr. Charles S. Howe, President of Case School of Applied Science in Cleveland, was asked to take the chair as permanent presiding officer of the Conference.

DR. HOWE: I esteem it a very great privilege to preside over this convention. First, I want to thank President Woods on your behalf for his kindly greeting to us and say that we are very glad to be his guests at the University of Maryland today. We hope that he and the members of his faculty will consider themselves guests of the convention and take part freely in all of these discussions.

You who are gathered here today are experts on various questions to be discussed. I do not intend to take your time. We shall proceed directly to the business of the conference. The first paper or address will be by Mr. MacDonald, Chief of the Bureau of Public Roads of the Department of Agriculture.

MR. MACDONALD: The questions which to me seem most important are those of an economic character. We have been able for the past two or three years to push forward a large program of road construction because funds were provided in ample amounts. During that period some states have exhausted, or practically exhausted, their credit as states by bond issues; other states are verging towards that point under existing laws. When I say "exhausted their credit" I do not mean exhausted the resources of their states but have exhausted their credit under existing constitutions and laws. In order, therefore, to maintain the program of highway improvement, which is needed to provide sufficient mileage, we must solve satisfactorily the financial questions involved. Highway bonds are coming into competition with other securities which may offer larger returns. Then we have the question of the service which we will obtain from the roads, and that we must answer from the economic standpoint so that we may know how much we are justified in putting into roads. So the questions which are of a major character now, it seems to me, are economic, or partially so, and it is to get the viewpoint of men of many minds and many occupations on these questions, and to bring these minds to bear upon their solution, that we have thought it desirable and advisable to have this conference today. It is looking toward the development of an adequate system of highways in this country, financed within our resources and carried forward at a rate as fast as our resources will permit.

CHAIRMAN: I shall call next on Professor W. Kendrick Hatt. Dr. Hatt is Professor of Civil Engineering, Purdue University, and Director, Highway Research, National Research Council.

DR. HATT: For the purpose of a coordinated and comprehensive program of Highway Research, I have been endeavoring to bring into the picture all the elements of the situation in Highway Transport,—Engineering, including vehicle and road; Economics of Transportation; Administration; Finance. Some comprehensive and logical assemblage will be helpful.

It appears that there are many dimly seen figures which should be advanced from the background; there is much that is unknown. We may ask a few questions which cannot be completely answered.

SOME FUNDAMENTAL QUESTIONS IN HIGHWAY TRANSPORT

The Transport Unit:

1. What is the economical highway truck unit for each of the several situations, e.g., intercity, farm to market?
What is the cost of transport arising from vehicle and from road?
2. What is the relation of this economical unit to other systems of transport, e.g., electric and steam, in a unified system?
3. To what extent, as a matter of public policy, should any transport unit be indirectly subsidized?
4. What traffic regulations should be imposed on such economical unit over other types of road?
What fees should be charged for service rendered to vehicle by the road?
5. What should be the proportion of the total traffic supplied by such economical unit to justify a special design of road for such unit?
6. What prediction can be made of future changes in general traffic and what is the influence of these on the economics of the present situation?
7. How should passenger traffic over the highway be evaluated?

The Road:

1. What type of road paving should be selected for a specified transport unit?
2. If the road cannot be economically fitted to the truck transport unit, can the latter be modified in design to fit the road?
3. How should the design of the road and paving be modified to meet changing conditions of subgrade, climate, etc.?
How shall sub-soils be improved?
4. What sum of money is the locating engineer justified in spending to avoid increase in distance, curvature, rise and fall, maximum grade, maximum curve?
5. What system of maintenance and organization is best fitted for types of roads, differing in traffic, in materials, and in climate?
6. What is capacity of a road of given width for type of vehicle as expressed in vehicles per hour, ton-miles per year, etc.?
What is the appropriate unit for expressing traffic for various purposes?
7. (In construction many questions arise in selection, production and economical use of materials, standardization and regulation).
8. How may the volumetric changes in roads be overcome?
9. What is the economical life of various types of roads, that is, when maintenance charges exceed earning value?

Administration:

1. What should be the policy in control of truck and bus transportation systems, terminals, routing, etc.?
2. What police regulations should control use of roads?

THE FIELD OF HIGHWAY RESEARCH

IMPORTANT ELEMENTS DEMANDING STUDY ARISING IN THE DIVISIONS OF I TO V

(STRUCTURES OMITTED)
(ELEMENTS ARE OFTEN INTER-RELATED)
STATIC CHART. COMMITTEE'S ORGANIZED TO OCCUPY FIELD

I ECONOMICS (DATA FOR ECONOMIC SURVEY AND STUDY OF PROJECT)	II OPERATION	III DESIGN (ROAD)	IV DESIGN (VEHICLES) AS RELATED TO ROAD	V CONSTRUCTION
I TRAFFIC STUDIES (REGIONAL) A DISTRIBUTION IN REGION & CHARACTER OF TRAFFIC, ETC. B. VEHICLE WEIGHT AND DISTRIBUTION SPEED TIRE CONDITION COMMODITY LENGTH HULL C. METHOD OF EXPRESSING UNIT OF TRAFFIC D. PREDICTED CHANGES E. OTHER TRAFFIC ON STEAM AND ELECTRIC ROADS F. CENTRAL SOURCES OF TRAFFIC	1. CONTROL OF TRAFFIC ROUTING TERMINALS FRANCHISES POLICE REGULATIONS 2. ACCIDENT INSURANCE 3. PLANNING SYSTEMS OF TRANSPORT FINANCING ENVIRONMENT RELATION TO OTHER TRANSPORT ORGANIZATION 4. FINANCING (SEE I) BONDS, TAXES, FEES 5. DISTRIBUTION OF COSTS TRAFFIC PROPERTY POLITICAL UNITS 6. MAINTENANCE SYSTEMS 7. MAINTENANCE MACHINERY ROUTINE REPLACEMENT SNOW REMOVAL, ETC. 8. MAINTENANCE METHODS ROUTINE OVERHEAD OPERATION MAINTENANCE ROUTINE REPLACEMENT ON ROAD ON VEHICLE EQUIVALENT UNITS X-AUTO = Y-TON TRUCK, ETC.	1. SUBSOIL STUDIES PROPERTIES IN MECHANICAL CHEMICAL DRAINAGE POWER SUPPORTING POWER IMPROVEMENT BY TREATMENT EFFECT OF ROAD DEFORMATIONS EFFECT OF CLIMATE DISTRIBUTION OF PRESSURE 2. BASE COURSE CHARACTER, TYPE THICKNESS MATERIALS CROSS SECTION 3. SURFACE CHARACTER THICKNESS MATERIALS CROSS SECTION WEAR BY TRAFFIC WEAR BY ELEMENTS IMPACT OF TRAFFIC TRACTION RESISTANCE WEAR OF VEHICLE WEAR OF SURFACE DUSTING INFLUENCE OF LOCALITY 4. ALIGNMENT CURVES (SPEED) GRADES	1. DESIGN OF VEHICLE POWER/GEAR RATIO POWER BRAKING ETC. 2. EFFECT ON LOADS SPRING UNSPRUNG DISTRIBUTION ECONOMY OF OPERATION AND MAINTENANCE (SEE AUTOMOTIVE INDUSTRY) ECONOMY OF OPERATION AND MAINTENANCE 3. SURFACE TRACTION, EFFORT WEAR ON TIRES LOADS MAINTENANCE OF VEHICLE	1. MATERIALS BITUMINOUS NON BITUMINOUS FUNDAMENTAL MECHANICAL METHODS OF TEST STANDARD TESTS SPECIFICATION AND TREATMENT (SEE SPECIAL LIST) PROPORTIONING 2. MIXING EFFICIENCY OF MIXER CENTRAL MIXING PLANTS 3. PLACING 4. METHODS OF TESTING ROADS INSTRUMENT CORES 5. DESIGN OF EXPERIMENTAL ROADS 6. DRAINAGE (AND DRAINAGE STRUCTURES) 7. IMPACT ON BRIDGE SIZE/DESIGN 8. REINFORCING HANDLING AND PLACING 9. INSPECTION 10. PLANT DESIGN AND CONTROL 11. COST ACCOUNTING 12. CONSTRUCTION CONTRACTS
2. COMMUNITY NEEDS SYSTEMS OF ROADS IN CLASSES FOR INDUSTRIES, ETC. INTANGIBLES				
3. COST OF TRANSPORT CAPITAL COST ROAD VEHICLE OVERHEAD OPERATION MAINTENANCE ROUTINE REPLACEMENT ON ROAD ON VEHICLE EQUIVALENT UNITS X-AUTO = Y-TON TRUCK, ETC.			4. CROSS SECTION WIDTH CROWN SHOULDERS DITCHES 5. LOADS STATIC IMPACT INTERVALS, AS EFFECTED BY DESIGN OF VEHICLE	5. CROSS SECTION WIDTH CROWN SHOULDERS DITCHES 6. SAFETY JOINTS SHOWING 7. VOLUME CHANGES 8. REINFORCING THEORY OF AMOUNT KIND DISTRIBUTION DIRECTION
4. ECONOMICS OF LOCATION COST OF DISTANCE RISE AND FALL CURVATURE RULING GRADE RULING CURVE				
5. FINANCING BONDS TAXES FEES ETC.				
6. HIGHWAY VALUATION INCREMENT OF LAND VALUES				

3. What is the best administrative and executive organization for administration and operation of roads?
4. What principles should govern the selection of a system of roads in its various parts, as influenced by interstate, intrastate, county, local traffic, etc.?

Financing:

1. What should be method of financing construction and maintenance of roads? What portions of cost from long term bonds, and what from current funds? What form of bonds should be issued and how create a market for them?
2. What should be the relation between life of bonds and economical life of road?
3. To what extent do social betterment, military use, i.e., social value, and other imponderables enter into highway policy?
4. What should be the distribution of costs as between Federal, state, county, township, property benefited, the user and other units?
5. How shall the future maintenance charges on completed road systems be met? Shall the user pay all of these?
6. How shall safety be ensured on the roads?

Answers to these questions cannot be made without data that are at present unavailable.

Research is necessary, and a mobilization of the efforts of research agencies in a comprehensive program. The Highway Research Committee of the Division of Engineering of the National Research Council has undertaken the coordination of such research. The National Research Council will not engage in research directly.

The chart reproduced herewith is devised to indicate the field of research as divided into subfields in which research should be developed, and from which data should come to enable answers to be made to these questions among others.

Some of the studies that should be made are as follows:

1. To develop a traffic census blank. Here a traffic classification must be made, the purpose of the census determined, and the various forms and instructions standardized.
2. *In order to determine the cost of transport* a statistical table must be made that notes all of the elements of cost; sometimes only a few of these are reported.
3. To study the operating costs of elements entering into location of highways, such as distance, grade, curvature.
4. To study loads on roads as produced by the vehicle.
5. To study design of vehicles with a view to lessening their effects on the road.
6. To study supporting power and improvement of subgrades and the relation to design of paving.

7. To study resistance of concrete slabs to alternate stresses and to surface loads.
8. To study proportioning and use of bituminous materials.
9. To study bonding of brick surfaces.
10. To study volume changes and the means of meeting them.
11. To study operations of concrete mixers.
12. To study the organization and economics of construction plants.
13. To study sand-clay, top-soil and gravel roads.
14. To study cellular and other new types of paving.

There is apparently a widespread activity in highway research throughout the United States on the part of the Bureau of Roads, the U. S. Army, the State Highway Commissions, the universities, and of industrial organizations, and an earnest desire to put highway construction on a scientific basis.

The economical features are under critical examination by such organizations as the National Chamber of Commerce.

We should be able to express quantitatively the results of a standardized economic survey of a road project, just as in the case of a water-power project for instance, except for those imponderables, which, like social betterment and public policy, influence the conclusions so profoundly.

It is not too much to say that the situation is critical, and that the sooner those interested come to a basis of fact the more assurance we will have that the public will not interrupt progress in providing for Highway Transport because of a general feeling of insecurity.

Individuals in industry who have endeavored to state the problem in approximate statistics tell us that there are ten billions of dollars invested in self-propelled vehicles, and that the turn over is three billions annually; that there are ten passenger vehicles to one freight vehicle, and that the problems of speed and safety are most important; that the annual expenditure for operation of vehicles is twelve times the annual expenditure on the roads, therefore the field of research on cost of vehicle operation arising from the road surface and from the vehicle itself must be kept in the foreground; that transportation by self-propelled vehicle is the most expensive of all commercial forms; it will increase. Everyone pays for inefficiency.

CHAIRMAN: Professor Hatt has given us an admirable analysis of the questions involved in highway matters, and this paper will come up for discussion as soon as we have finished with the general subject of highway transport. The next speaker is Mr. Roy D. Chapin, President of the Hudson Motor Car Company of Detroit.

MR. CHAPIN: It seems rather appropriate, to think it over, that the conference on this important subject should be held in Maryland. The first great activity in highways in this country of an interstate scope started in Maryland. As you remember, the Old National Road began at Cumberland and ran westward, so that Maryland has always evidenced an interest in the development of highways and highway transport, and probably went as far in

utilizing highway transport a hundred years ago as any other state. Highway transport is perhaps more comprehensive in its scope than most of you consider it. I visualize highway transport as covering the entire subject of both the building of the road and transportation over it, exactly as when we talk of railroads and railroad transportation we mean the unity of both the roadbed and the traffic over it.

In the economics of highway transport it seems to me that we are studying something which not only has a general basic result in the cost of living and happiness of our American people, but also has a very important bearing upon our financial situation. It is a well-known fact today that in some states the funds appropriated for highways are, as has been said, largely used up, and it is going to be a question of getting further bond issues. Now on what basis can you get further bond issues? There is only one way and that is, because the roads that have been built have returned dollar for dollar, that the taxpayer can be convinced that the new roads that are to be built under new bond issues will return dollar for dollar.

We must not overlook the fact that railroads are finding tremendous difficulty in financing themselves. Why is that? Very largely because of lack of sound economic study of their problems when things were going easily, when they could get their money easily. We are getting money easily today to build highways. During the past few years an astonishing number of state bond issues have been passed all over the country, and the ease with which those campaigns have been put through recalls the old phrase "Easy come, easy go." There is a possibility that within the next five years we shall find the taxpayers of this country in this mood: "We have not had a dollar's worth of value in highways and highway transport for the dollars we have given; therefore you cannot have any more—you have to show us." We certainly do not want development of highway transport to fall into the same situation as the development of rivers and harbors of this country, because today plenty of very necessary projects find it impossible to get any money. We are coming to that, I believe, unless the men seated in this room and others will collaborate, will put their brains together on this question and will develop some basic laws in highway building and the use of the highways, and, further than that, in the relation between highway and vehicle, so that we shall have a sound development for the benefit of every taxpayer and every citizen of the country.

I do not think it is generally realized that at least ten billion dollars today are invested in vehicles alone operated over the highways of this country. By that I mean self-propelled vehicles, leaving out entirely horse-drawn vehicles and other types used over the roads, investments in carriages and other collateral business that goes with the use of the vehicles. It has been estimated by the United States Chamber of Commerce, that twenty-one billion dollars are invested in highway transport in this country, including the improvements on the road but nothing for right of way. That represents more than the total investment in railroads in the United States. Today the new investment

going into railroads, the building of new roads, is insignificant. The building of highways and the use of highway vehicles is the great new development in transportation in the United States. In addition to the twenty-one billion dollars invested there is an annual maintenance charge on highways and on vehicles which has not been at all accurately calculated so far, but I venture to say that it is equal to that of the railroads, if not greater.

It is the duty of this conference to outline very specifically, if possible, the problems in highway transport that present themselves, and make these subjects of general study throughout the country. We have got to look at this question just as today we are looking at the railroad problem. We are not concerned merely with the railroad that runs past your factory and through your town, but with railroads as a whole, and the highway transport problem of this country as a whole. We should nationalize as much as we can. Many of our systems connected with highways should be made as uniform as possible; for example, laws regulating the use of highways and vehicles. With ten billion dollars invested in vehicles alone, not including horse-drawn vehicles, have you not a very serious problem, not in the relation of the vehicle to the road, of which we have heard so much in the last few years, but in the relation of the road to the vehicle? Within two or three years, or five years at the outside, almost every taxpayer in the United States will own some kind of vehicle. Have you not thrown on that taxpayer, by virtue of poorly built roads, ill-considered roads, roads running over the wrong routes, and in many other ways, an annual maintenance charge on his vehicle which is out of all proportion to what he should pay? If you have increased his haulage cost, either passenger or freight, you have an uneconomical situation which must be corrected. The taxpayer supplies the money and he has got to be shown.

In the programs that have usually been presented we have not given enough study to the question of freight vehicles; that is, haulage of goods over the road. Possibly we can go further in the question of haulage of passengers. The proportion of vehicles hauling freight and passengers today is one to ten. This proportion is going to change. The percentage of freight vehicles will increase. The Bureau of Public Roads has stated that its research programs have been devoted to trucks over the highways and not passenger cars, because any road that will stand up under truck traffic is all right for passenger car traffic. That may be so as far as actual wearing surface is concerned, but the problems of route and of speed throw a new burden on the highway engineer. You have also, and this evidently comes within the field of economics of highway transport, the problem of building safely, and certainly nothing is worth more than the saving of lives.

If it has been demonstrated (and I think during the war it became quite clear) that short-line railroads, in most instances, have outlived their usefulness because the motor truck has taken their place, is not the time coming when you are not going to build new interurban street car lines? The highway vehicle that can run on any route—a route which can be changed at will—will supersede the street car.

There is one thing I want to emphasize again. The time has come when this question must be studied from the national standpoint. In other words, the time for merely local investigation, local plans and local development is over. Every single thought that we have in America should be put into one common melting pot, and I hope particularly as a result of this conference that basic laws may be laid down which will not only develop the highways from an engineering standpoint but will develop traffic over those highways—which is the only reason for highways and vehicles—along sound economic lines which will be just as valuable for New Mexico as for New York and Maine.

CHAIRMAN: The question of highway transportation is so closely connected with that of marketing that I am going to call on Mr. L. M. Estabrook, Associate Chief of the Bureau of Markets and Crop Estimates of the Department of Agriculture.

MR. ESTABROOK: The officials of the Bureau of Markets and Crop Estimates realize the tremendous economic importance of highways in transporting farm produce. Recently I had occasion to have some figures collected for the Joint Congressional Committee on Agricultural Inquiry in relation to the cost of freight rates as applied to farm crops. The figures compiled may be of interest to those here. It is estimated that annually about 153,400,000 tons of farm produce move over the railroads at a cost of considerably more than a billion dollars in freight. All of that tremendous tonnage is first hauled over country roads and, of course, in addition there is a very large tonnage which never gets on the railroads at all. Each haul to shipping point or market involves a return trip. Furthermore, there is a tremendous tonnage in the aggregate of farm equipment, machinery, implements, fertilizers, and supplies of various kinds required to maintain and operate nearly six and one-half million farms and nearly fifty million people, hauled to the farms over country roads. In a meeting of this kind it is sufficient to merely mention the fact that accessibility of farm to market is one of the most important factors in the conduct of this eighty-billion-dollar industry, it is an important factor of good farm management and of the individual farm business. Accessibility of farm to market is synonymous with good roads.

The Bureau of Markets and Crop Estimates is undergoing a reorganization and some redirection of its activities at the present time. It is contemplated to bring in the office of Farm Management during the course of the next year, assuming that Congress will authorize the consolidation, and the combined work will be directed more along economic lines than in the past, the consolidated bureau to be known as the Bureau of Agricultural Economics. With the personnel and equipment of this combined bureau we expect to have better facilities in the future for making inquiries on a country-wide basis relating to the various factors involved in the marketing of farm products, which, of course, includes transportation. It is quite likely that this bureau will be in a position to supply information of great value in connection with the economic studies

which this conference is outlining today. It should be possible to estimate with a fair degree of accuracy the number of miles of roads of different character in each county and state, the number of farms served by each mile of road, the tonnage hauled from and to each farm per month and per annum on the average, the number of days when roads cannot be used because of bad condition or weather, relative size of load hauled at different seasons over different kinds of roads, and the consensus of opinion of the farmers themselves as to the kind of roads that will best serve their needs—in other words, some of the data which road engineers, economists, business men, and legislators need in order to map out a constructive, long-time program which will result in developing a system of roads of greatest value to the greatest number of people.

CHAIRMAN: The next general topic is Highway Finance. Mr. A. J. Brosseau, President of the International Motor Company of New York, will open the discussion.

MR. BROSSEAU: The most important problem before those who are interested in highways is the question of finance. The roads will be paid for by the taxpayer, but if the public, who is both taxpayer and user, realizing the advantages of highway transport, decides to build highways that are open to all users, it is, in effect, really building roads for its own use. If we are to ask the public for money to build roads to promote highway transport, we shall make a big mistake if we do not build properly.

Obviously the road must justify itself as to cost. It is as big a mistake to build too well where the traffic does not justify, as to build not well enough. If such mistakes are made, money will be thrown away, and the public, who may not analyze the problem thoroughly, will say—"This highway thing is no good. We have spent a lot of money for roads that have been ruined, and what is the use?" If such a state of mind is created, it would take years to overcome the prejudice.

The railroads, in their early days, built cheaply, without regard to the requirements of traffic and without regard to the future, with the result that the roads had to be rebuilt. We cannot afford to make the same mistake with highways and highway transport. The public will willingly furnish money to build roads that are justified by the traffic, whether for motor truck, motor bus or passenger car, and they should not be asked for more. When I say the public, I mean the taxpayers.

I have here the *Journal of the Engineers Club of Philadelphia** and will read a short excerpt from one of the articles.

"Future conditions cannot be foreseen with accuracy, but in building roads, the possible or probable changes should be estimated and provided for. It may be assumed that in practically all cases the improvement of a road or street will increase its importance, probably result in improvement of the adjacent property to a relatively high degree, and increase the amount and severity of the traffic to be carried by the road. Hence it seldom, if ever, occurs

* Volume 38, page 230 (June, 1921).

that a character of results which will just satisfy present conditions most economically will be efficient, or even satisfactory, within the first few years after the completion of the road."

This article prompts me to call to the attention of educators, economists and others who are expected to teach the fundamentals of Highway Transport, that the facts herein stated must be impressed upon the public. If they are not, I am fearful that many roads will be built so poorly that they will not carry the traffic, and the result will be that the whole highway system will be condemned.

As a rule, when one speaks of improved highways, the average man thinks of a very heavy concrete road built at a tremendous expense. Such roads are not needed everywhere. It is highly important that we have a system of primary roads that will carry the heavy traffic in congested districts, but they should be built only after careful analysis has been made to determine whether the traffic will justify the expenditure. We also need a system of secondary roads that may be hard surfaced, but not particularly heavy in order to meet the needs of local traffic conditions. There is, of course, a tremendous volume of traffic on these secondary roads, but the unit as a whole is light and the distance short. If the highway problem is approached in this way, we can develop a satisfactory and completely efficient system of highways.

The construction cost of primary roads should be shared by the federal and state governments, and the funds contributed by the state should be provided for by bond issues. While at first sight the question of maintenance may not seem to directly affect the question of finance, I am convinced that it is one of the most important elements. If the taxpayers approve of bond issues with which to build roads, they have a perfect right to insist that these roads shall for all time be properly maintained. They will not approve future bond issues if, because of lack of maintenance, the roads are destroyed long before the first bonds are retired.

The present system of taxing motor vehicles—whether passenger cars or trucks—is right in principle, but great care should be exercised to make sure that such fees are not unreasonable. The state should expend the fees assessed against motor vehicles, trucks, buses, gasoline tax, etc., for maintenance purposes, and the money should be fairly apportioned to maintain primary, secondary and all other roads, but no part of it should be spent for new construction. My definition of maintenance is to do such repair and reconstruction work as may be necessary to keep the road always in as good condition as when it was built.

Our steam-road friends tell us that they built their roads and maintain them at their own expense and that it seems unfair to them for the taxpayers to build roads which the motor vehicles use without charge. I told a very good friend of mine—a steam-road man—the other day, that I did not know they had built their roads, but supposed, on the contrary, that they had gotten a great deal of help. He smiled, and there was no more discussion. Steam-road

owners and others who state that the motor vehicle is subsidized because of the free use of roads built by the public forget that the steam road enjoys a monopoly, and that the highway is open to all.

CHAIRMAN: Professor J. Gordon McKay, Economist of the Bureau of Public Roads and Professor in the University of Wisconsin, will continue the discussion of Highway Finance.

PROFESSOR MCKAY: The highway economist, engineer and administrator will agree that there is urgent need of extensive economic research in the solution of the complex problems of highway valuation, finance, and administration. A wide range of difficult problems confronts the investigator in the field of highway economics from the intricate task of valuation to the less difficult problems of administration.

Naturally the first step is to select the subjects for investigation. The second phase is the determination of the major problems requiring immediate investigation. The third phase, or investigation of major problems, requires certain preliminary research prior to field work and experiment, such as surveys of primary and secondary sources of information, and the correlation of unpublished data in the possession of national, state and private agencies working in the same field, that the best results may be obtained and waste of time and duplication of results may be avoided. The fourth phase of investigation is the actual research and experiment in the field.

In the following outline an attempt is made to develop the first two stages, the selection of problems, and their organization with regard to their importance as subjects requiring immediate investigation.

HIGHWAY VALUATION .

1. Elements in a plan of highway valuation.
2. The evaluation of the several classes of highways.
3. Increment of land values due to improvement and the zone of increased land values as a basis of real property taxation.
4. Possibility of decreased land values due to improvement, when taxation due to improvement increases, or traffic over road increases to point where ownership of land is more desirable away from improvement.
5. Mileage unit measure of vehicle traffic.
6. Limit of economy and waste in highway construction and maintenance.
7. Average economic life of principal road types.
8. Analysis of principal factors involved in selection of primary and secondary road systems.
9. Standardized outline and purpose of a traffic census.
10. Maintenance, a factor in road valuation.

FINANCE

1. Sources of revenue for administration, construction and maintenance.
2. Highway funds available for road building, 1921 to 1925.
3. Future source of highway funds and control over expenditure.

4. Permanent and temporary bond financing of highway improvements.
5. Maladjustment of term of highway bonds to life of improvement.
6. Insuring a market for highway bonds.
7. Relatively increasing and finally decreasing volume of highway construction funds as systems near completion, constantly increasing volume of maintenance funds.
8. Distribution of building costs between federal, state, county and township units.
9. Theory of highway finance.

ADMINISTRATION

1. Classification of highways.
2. Distribution of administration, control, construction, maintenance and financing between federal, state, county and township units.
3. Centralization or decentralization of highway administration and control.
4. Planning of administration, engineering and financial policies under budget system.
5. Uniform trail marking.
6. Uniform vehicle license legislation.
7. Cost accounting, basis of contractors bids.
8. Digest of highway legislation.
9. Model highway law, an outline.

The problems outlined above are divided into groups in the order of their relative importance, with highway valuation as the most significant and without much question the most difficult. The increment to farm land values due to road improvement illustrates this point. We cannot take as the measure of increased rural land values merely the difference in assessed valuations before and after road improvement, without offsetting increased valuation for taxation purposes, increased price of farm produce during the same period, and the natural increase of land values due to increasing population in proportion to our limited land supply. It is fundamental that we determine as accurately as possible the service value of our highways so that we may intelligently compare construction and maintenance costs of a given road mileage with the service value or utility of the same mileage. We must answer the question of property and vehicle owners: Are we building roads giving maximum service at a minimum cost?

Sound financial policies cannot be developed until the information is secured which must be the foundation of a sound program of highway finance. For the time being we can do no more than suggest a broad outline of highway financing. Construction and maintenance are not major problems since they are determined by the vehicles which we permit to pass over our highways and cannot economically prescribe the vehicles which should move over the highway. Administration, while presenting some difficult problems, can be neglected for

the time, since it does not assume a position of major importance in comparison with valuation and finance.

This outline, if it truly portrays the highway problems of today, is suggestive of the field of highway economic research, a framework upon which we may build, with fact and not fiction, highway policies. If it receives criticism which will add to it more important problems, or eliminate from it problems of lesser importance, it will have served its purpose.

CHAIRMAN: The next topic is "Economic Problems of Construction and Maintenance." The first speaker is Mr. M. O. Eldridge, Director of Roads, American Automobile Association.

MR. ELDREDGE: Our organization is intensely interested in all phases of this subject, especially those phases which deal with the question of classification of highways, economics of operation, construction, maintenance and the financial problems involved. Some people seem to have the impression that the motor vehicle owners of the country are desirous of obtaining only high class boulevards everywhere. This is a mistaken impression, because the great bulk of car owners realize that we cannot build expensive high class roads everywhere and all at once.

There should be first a scientific classification of the highways into groups of varying importance, depending upon their traffic and economic value. The more important roads should then be graded, drained and surfaced with the more durable classes of materials, the secondary classes of roads should be graded, drained and surfaced with the less expensive or temporary classes of materials such as broken stone, gravel and sand-clay, and the less important or local roads should be graded, drained and maintained by dragging wherever the traffic justifies.

There is great need for accurate and uniform traffic information which will develop a quantitative and qualitative analysis of traffic over the highways. Many traffic studies have been made in the past, but they have not been uniform nor have they been properly correlated. Traffic forms of one State are different from those of another. Before additional traffic counts are made the forms now in use in different States should be studied and a uniform blank made up so that the records may be comparable.

Another fruitful field for study and research is that of safety. College students and research agencies could very well afford to devote some of their time to the study of safety problems. The need for safer highways is shown by the fact that last year three times as many people were killed at grade crossings in the United States as were killed on the American side during the entire Revolutionary War. There are probably more people killed as a result of automobile accidents in the United States each year than from any other one cause. Highway hazards of all kinds should be analyzed and the remedies sought.

CHAIRMAN: Mr. John N. Mackall, Chairman and Chief Engineer, Maryland State Roads Commission, is the next speaker.

MR. MACKALL: There has been little or no study given to the economic problem of highway construction and maintenance. That is a rather strong indictment, but in my judgment it is true. I have seen roads destroyed to build new ones when perhaps the interest alone on the construction of the new road would far more than offset the entire cost of maintenance on the old road. We have got to go a little further and stop the competition that is going on and has been going on for years between the truck manufacturer and the road maker, which is similar to the competition between the safe breaker and the safe maker. Let me cite a specific example, our road running by here.¹ In 1917-18, that road carried a tremendous traffic, not so great in number of units as in size of units. For practically its entire length in April, 1918, it was impassable. It could not be used for anything except very light trucks. The cost of rebuilding that road in 1918 was \$600,000. A traffic count was taken for the twelve months preceding reconstruction. It was not accurate but was approximate. A comprehensive study was made of that traffic count and it was demonstrated by the Bureau of Public Roads, in a statement which they published, that if all the units of 5 tons or larger had been carried on units of 3 tons, taking the manufacturers' rated efficiency, the cost to the operators would have been \$15,000. The people of the State of Maryland paid \$600,000 to permit a few truck operators to save \$15,000. It is a very serious proposition, and I hope this conference is the beginning of a correlation of road building and road maintenance to road operation.

Some of the speakers, Mr. Chapin particularly, brought out the fact that the road in itself is of no value—vehicles are of no value—it is highway transportation. Certainly, then, the road builder and the road user want identically the same thing, namely, a road that will give service every day in the year. You cannot get that unless you correlate road construction and maintenance with size, speed and weight of vehicles using the road.

CHAIRMAN: The next speaker is Mr. N. W. Dougherty, Professor of Civil Engineering at the University of Tennessee.

PROFESSOR DOUGHERTY: For a number of years we have been giving a short course in Highway Engineering. Engineers, county road superintendents and others have become interested in the work. About two years ago we decided to undertake an enlargement of our field of instruction by giving some instruction in Highway Economics. The material given that year was sandwiched into the course on Highway Engineering and studied in connection with surface selection. Last year we enlarged the scope of the work and gave a six-weeks course on what we called Highway Economics and Highway Organizations.

The course was outlined about as follows: Discover, if possible, the cost of construction of the types of surface, giving due weight to such items as distance, rise and fall, and curvature; discover the cost of maintenance of the several

¹The main highway between Baltimore and Washington.

types; determine the probable life of the pavements considered; investigate the sources of material supply; determine the financial condition of the highway unit; find out the traffic on the road and the traffic that may be expected during the life of the surface, and finally, undertake to choose a type of construction that will serve the needs and do it with a minimum cost. Special stress was placed upon the fact that annual cost of operation of traffic over the roads is as much a part of the highway problem as the building and maintaining of the roads. The same public pays the bill, whether it be for building roads or for transporting freight and passengers over them.

In our study we found a great dearth of reliable cost data. It is doubtful whether anyone knows the exact cost of rise and fall or curvature, or, indeed, many other items which enter into the location and construction of a highway. The information on maintenance is very meager, and highway users have just begun to realize the need of exact data on the cost of operation. In giving this work we tried to stress the need of accurate data and the further need of a careful study of the whole problem before expending large sums of money.

There is no question in my mind that we are building roads which are not justified by the probable traffic during the life of the road. We are all familiar with roads that are so bad that large sums of money could be profitably expended to avoid the "bad road tax." We have, on the one hand, roads so poor that they cannot be traversed, and on the other hand constructions so expensive that they are not justified. It is only by a study of the whole problem that a reasonable solution may be obtained.

Let us take the example of two counties of practically the same area and having approximately the same road mileage. In one of those counties the taxable property is twenty times as great as that of the other. Certainly the problems of the two counties are vastly different. I have heard road builders say, "The only type of road I am willing to build is — (high class) surface." If an earth road can care for the traffic most economically, the earth road is the type that should be used. If an expensive type of surface is necessary, the expensive type should be built. In studying the problem, however, all items should be considered. It will not do to study maintenance alone, or maintenance, first cost and depreciation alone, but the whole problem of first cost, depreciation, maintenance and cost of operation must be studied. The same public which pays for the building of the road pays for its upkeep, and for the transportation over the road. The whole people are benefited in some way, some directly and some indirectly; all will be benefited if the work is properly done. The problem is one of transportation and should be so studied that the cost of transportation may be a minimum. We should build a road that is satisfactory to the highway need and let those who get the benefit from it pay for it.

CHAIRMAN: The Highway and Highway Transport Education Committee was established with Dr. P. P. Claxton, then Commissioner of the United States Bureau of Education, as its chairman. Dr. Claxton has taken a great interest

in this subject and I will ask him to lead the discussion of the topics considered this morning.

DR. CLAXTON: There is no reason, as far as I know, why I should open the discussion, except to call attention to the fact that it is an educational question. Like everything else in a democracy it begins in and returns to education. I am exceedingly pleased at the results that are coming from the conference that was called on education for highway engineering and highway transport a little more than a year ago in Washington. Some of you gentlemen were present. That conference was called, not for the purpose of discussing highways primarily, but to discuss what the schools—high schools, universities, technical schools—should do toward educating people for the building of highways and their use, for the economic use of automobiles and trucks in transporting passengers and freight and general support of the highway building program. That still is an important thing and to that I wish to speak very briefly.

From what has been said here this morning and at all of the meetings of this committee, it is very evident that much must be done in the way of research in regard to the building of highways—the kind of highway to be built in any particular place, the kind of material that would be best adapted to the climatic condition of that particular section, the type of road to be built for the use that is to be made of it within the next few decades; then to teach these things in a reasonable number of institutions. It is something that we cannot hope to teach fully and completely in every state. Not every university of high rank can teach highway engineering of this type. It brings up one of the great problems of education in this country, not only in regard to this but many other phases. We have no national system of education. State universities are under obligation to serve their particular States, and they have before them the development of the future. Their endowments are much larger than any private institution like Harvard, Yale or Stanford. No endowment fund is as large as the wealth of all the people. You have the possibility of funds far beyond what you may expect to get from individuals or any particular group giving funds voluntarily. But if Maryland, Virginia, West Virginia and Kentucky and all the other States may not maintain fully developed departments of highway engineering and economics, there must be some way by which students from one State may use the schools of another State. And possibly it is a thing of this kind that will bring about nationalizing highway educational work in the United States.

A bill well known to you all has been pending in the Congress of the United States for a good long time—a bill which will appropriate money for elementary schools. It is far more important that the higher schools like the State universities should be considered as national organizations. At a conference last year in Washington there was a committee from the paper manufacturers wanting us to discuss the technical side of work on wood pulp. Evidently there should be instruction in that particular subject in a few institutions in the United States, but not all. Nevertheless the students attending State univer-

sities ought to have free access to these. That is a great problem the educator of today will have to discuss. How can you bring it about to give the best instruction in departments most fully developed in all of these subjects at such a number of institutions located as may be most desirable? The research work can be done very largely, of course, through the Research Council, through cooperation with the State departments, State universities and engineering schools, and, as already suggested, by correlating experiments going on in practical ways throughout the United States.

This morning the question was financing, the economic side of the whole thing. Here is a place education must reach not only a few men here and there throughout the country who are authority on the subject, but the masses of the people must be brought to understand something of that, something of the common wealth in which they have a part. May I say parenthetically that I think it is important now to bring the people of the United States to understand that there is a common wealth, and when a man contributes his little part and other millions contribute their part, the man who contributes a small part has a full share in all he can use of all of it. The larger part he can contribute, the wealthier he becomes. Mr. Rockefeller, Sr., has today a larger heritage, a larger part out of the common wealth of the country than out of his own private, individual wealth. The road we drove over this morning was worth a dollar to each one of us. There is such a thing as the common wealth, the general prosperity of the country, the thing we all can use when we need to use it, and the highway and highway transportation belong to that class of wealth.

Another thing is the question of the amount this common wealth adds in possibilities of individual wealth. That must go to the masses of the people. We all agree in the principle of no taxation without representation. We must adapt this that there shall be no attempt at taxation without understanding, without instruction, knowing what they are paying for, what use is to be made of it and what benefit they will finally get out of it. I am not in sympathy with what I have heard here this morning (I am, however, in sympathy with a modification of it) that the man who hauls in a truck over the road or in his automobile should be made to pay for the road. We do not do that with other things. I have been interested for forty years in public school systems. We call any school a public school regardless whether the tax is collected by the tax collector or by a man who goes around to great tax collectors like Carnegie and asks them to hand over a portion for schools. No matter what officer collects the taxes they are, after all, paid by the people. We have long ago passed by the point of collecting taxes only from the people using the schools directly, the man who has children to send. The millionaire who has no children to send or who otherwise provides for their education is a user of the public schools just as much as if he had a dozen children to send. General prosperity is concerned. Some of us paid taxes for the great war who ourselves did not go and use those guns and did not believe we were in immediate danger of having our property on this side destroyed. It was for the public welfare. The public school system is for the public welfare, and road building is like that.

We must teach something in regard to highway economics in our colleges and universities, in our high schools and elementary schools, and to the present generation who have already passed that time, by some means of extension. I was recently at a conference at the University of Tennessee. Until fifteen years ago it had no support whatever from the State of Tennessee. They never gave a dollar to it. So rapidly has it grown in the confidence of the people that four years ago \$1,000,000 was appropriated by the legislature for new buildings. At the conference great emphasis was laid on the question of research. Mr. Moody, of the *Commercial Appeal* of Memphis, made a brief talk on educational extension, getting information to the people, letting them know about it. He said, "For years you have been trying to get things, but the people had to give you the means to do it. What is the use of winking at a pretty girl in the dark?" It was worth my time and money to go to hear that figure of speech, and it will be worth your time listening to me if you will remember it. What is the use of complaining about the people not giving money when they have not been instructed? We shall get in the United States an adequate system of highways for general use of the people when we have educated the people through colleges, universities, high schools and extension agencies to the value of the highway and of motor transport, and to the good economy of paying out of our individual wealth enough that they may have their full part in the great common wealth which is thus produced.

CHAIRMAN: I am sure many of you here would like to discuss the papers or addresses, and I am going to give you this opportunity. We have a very short time, and I am sure many of you either agree or disagree with what has been said.

MR. BROSSEAU: I would like to ask Commissioner Mackall of Maryland how he determined that the 5-ton truck ruined his road.

MR. MACKALL: Perhaps we determined it in a very elementary way, but I believe we determined it satisfactorily. At least our methods have produced results. Prior to the year 1918 there was no limit to the weight of motor trucks which could use our highways. The law said that the limit should be 14 tons—28,000 pounds—but no attempt was made to enforce it. In 1918 the highways were destroyed in many sections, and the legislature said in unmistakable terms that "no motor vehicle having a greater rated carrying capacity than 5 tons shall be operated over any public highway in this State" and that "the limit of load per inch in width of tire shall be 650 pounds." Since then the law has been rigidly and vigorously enforced, and today there is perhaps less than one-half of one per cent of overloaded trucks. Since 1918 not a failure on any section of highway in the State has occurred. Perhaps there were many contributing causes in 1918, and perhaps all the causes have been eliminated. However, this fact remains—we eliminated one cause and eliminated all failures.

MR. BROSSEAU: The reason I asked the question was this. I drive over a section of road known as the Boston Post Road, well built for heavy traffic. In 1918 the second failure on that road occurred. It was determined there to

the satisfaction of many people that the road heaved up and broke down. I just wanted to know if that condition might not have obtained here.

MR. MACKALL: Maybe. The winter of 1919 was the most severe winter ever experienced in this locality, and the winter of 1920 was the mildest. There was no failure either year. I don't know that I disagree with the large number of people who say we should build better roads and should have built better roads. Maybe we should, but we didn't. In Maryland we have 2,200 miles of complete road in a total of 15,000, a larger percentage than any other State in the Union. They cost \$30,000,000 when they were built, and it would cost \$60,000,000 to replace them. What are we going to do about it? Are we going to limit the load or are we going to do as some would have us do—permit any load that a manufacturer chooses to put on that road and destroy the roads for all? In 1918, when the law was passed prohibiting licensing of vehicles having a greater rated carrying capacity than 5 tons, approximately 150,000 vehicles were registered in Maryland, and 17 motor trucks larger than 5 tons. It would have been infinitely cheaper to have taken every one and substituted 3½-ton trucks and paid the owners for the rest of their lives the difference in cost of operation than to repair the damage the 17 trucks did.

MR. PRIDE: The 17 trucks didn't break the roads.

MR. MACKALL: There were 17 owned in the State, and we think perhaps the foreign trucks contributed somewhat to the damage. We think also some of the other trucks of a rated capacity of less than 4 tons carried more than that.

AFTERNOON SESSION

CHAIRMAN: The next topic is "Highway Administration," and the first speaker is Dean Chas. L. Raper, of the College of Business Administration, Syracuse University.

DEAN RAPER: Since going to Syracuse I have been interested in questions of operation and cost of operation of roads. When the chair of transportation was endowed, there were no strings attached to it, and the Department of Transportation was to be developed as science demanded it. Everything we have been doing in the field of motor transport has the background of rail transportation. The department is just one year old, and last fall there were not many students able to take the course profitably. About twelve men started out with that course, representing eight sections of the country from middle Michigan to Long Island. We soon found they were not very much interested in the administration of a highway but were interested in the question of the cost of operating a motor car. Each man took it upon himself to consider one definite problem. One man made a study of the cost of operating trucks in Syracuse. He found that only one firm in that city had ever given very much thought to the cost of its motor truck fleet. This firm had gone into many phases of the question. By the middle of last year every single truck it owned had pneumatic tires. They started with solid tires. They didn't care about

the streets, they belong to Syracuse, but they did care how much damage was done to the trucks and to the goods which were hauled.

Another student made a study on Long Island delivery of bread a distance of 60 miles and found that little was known about how much it cost to operate. They delivered the bread and didn't think about the cost. One man did, and found that if he made a careful study of the operation of his trucks he could outsell his competitor, deliver bread farther out and make a profit. The result of those studies convinced me of two or three things. The average man who owns a motor car hasn't thought very much about his car, doesn't know how much to charge you for carrying you 5 miles on the basis of cost of operation, or how much to charge if he carries a ton of freight. It is all haphazard guesswork. Further, the moment he does begin to think about how much to charge for carrying goods, he is up against the highway. On a perfectly smooth, hard-surfaced road, the resistance per ton is small. You have to consider what kind of material the road is made of. Another question is that of a 5 or 2 or 7 per cent grade. The grade hits you with resistance just as the surface does. Suppose you have a 5 per cent grade. That increases the cost of gasoline, oil and many other things to the owner. Is it wise for the public to cut the grade down to 2 or 3 per cent? These twelve boys made a study in ten different sections. The result, while immature—they were only juniors or seniors at college—was exceedingly satisfactory when it came to educating boys, and I believe satisfactory when it came to the public's interest.

About administration. Every man who has toured over a dozen roads in this country has one definite conclusion. The administration ought to be centralized as much as possible. I have long since come to the conviction that the county system is bad if the county is completely independent. You have got to have a state-wide system and you should have a national system of administration to work with the state system. The administration of highways is coming to be almost national in its point of view. I hope it will never go back to the local unit of a township, county or town.

CHAIRMAN: Questions of safety for the traveling public are of great importance in connection with the administration of highways. The next speaker is Mr. Clyde Jennings, Managing Editor of *Automotive Industries*, New York City.

MR. JENNINGS: The other day, at Broadway and 39th, I walked up to a man who has been in the automotive industry ever since it began, and asked him what he was thinking about. He said, "I was just standing here wondering how in the world anybody ever got run over before there were automobiles." They did, quite a number of them, and that illustrates how rapid our education has been in the fact that some of us have not been run over.

We don't know yet the fundamentals of this accident situation. We seem to be in a sort of a daze in which we are gathering statistics. Almost anything that you can put in figures looks good and anything you can draw a curve on looks fine, and we say that is settled; we have got a curve. We have a curve on accidents, but we haven't got the right one. Not long ago the New York

newspapers were going very strong on the immense number of people who were killed in New York, especially Manhattan, by automobiles. They had but one cure, and that was the licensing of the operator. It was almost impossible to get a statement from them that the proportion killed in New York City was smaller than in any other city, and smaller than in many country districts. We finally got that across. The Health Department of New York City came out with that statement the other day. I took it up with one of the papers that was crusading on accidents and a consideration of the facts presented has made that paper much more reasonable in its treatment of the subject.

Now we need actual statistics in New York and every other community. There was a movement on foot to find out when and where the accidents happened. The plan was to have 2,000 more traffic policemen, but where were they to be put? On Broadway? The accidents do not happen there. They tried to prove that they did, but they didn't. That shows the public feeling that accidents must happen where there is the most traffic. That doesn't necessarily follow. I hope to get in New York City an examination into every individual accident, as to where and when it happened. Next I want an inquiry into each accident as to why it happened. If we can get that information without arresting a man and putting him on the defensive and making a liar of him, we will have something very interesting. It may be the pedestrian's fault, it may be the driver's fault, or it may be the fault of the machine.

One of the engineers said the other day that the 4-wheel brake should be legislated onto the automobile. Another said, "Let us first find if we have a 2-wheel brake." It is a very serious question, as to how effective and how well maintained the brakes are. I do not know personally of an instance where after an accident a proper examination has been made of the brakes, steering apparatus, etc., that are vital in accident prevention. It is necessary to get fundamental figures and facts, things that go back into the cause of accident. The road curve must figure in the liability for accident. The width of the roadway is a very important factor.

In seeking to prevent accidents, an error was made by the State laws limiting speed. There have been a few judges big enough to size up this situation and say that speed is relative. Six miles an hour at one place may be dangerous, and 12 miles at another place may not be dangerous. All these things will have to be examined carefully.

Recently a big element in the safety problem—I think for the last year or two perhaps the biggest element—has been the almost criminal practice of issuing accident policies. You could get accident insurance for anything and any amount, and the man who caused the accident was not penalized or even blacklisted by the insurance companies. Now there is a movement among the insurance companies to make the owner or operator of the car assume the first \$50 or \$100. That is a very good thing, it throws some responsibility back onto the operator. As long as he could over-insure his car against liability, which released entirely the man who caused the accident from any feeling of

responsibility, there has been an increase of accidents. I know of some perfectly conscientious men on other things who seem to have no regard for the life of an unknown person and, as to accidents to their machines, they have 4-year-old cars insured for the price of new. This is coming to a halt by protest of the people who have to pay the bill. A great many owners are now carrying their own insurance because of the high price, and that is due to over-freedom with which insurance was issued.

We have been able to demonstrate in New York that the operator was much more amenable to law than the pedestrian. The Fifth Avenue experiment shows this. Remove the traffic policeman from the corner and the operator will drive up, and when the light is against him, three blocks away, he will stop. The people walking up and down will weave in and out of the vehicles, seem to want to get run over. Education should go to the pedestrian. I wouldn't advise letting up on the operator, but I think the educational course on him is working fairly satisfactorily. Accidents cannot be controlled by licenses entirely. A license is a good thing, but you can't keep accidents out; they will happen to the most conscientious of drivers. I think a very good thing would be the publication of a driver's code calling to the attention of every operator of a machine that speed and control of the machine should always be regulated by the surroundings, so that you cannot be surprised into hurting anybody. If you are driving behind another machine, where the people are liable to step out, you should watch and be careful. A good many would so govern themselves if such a thing were put before them in an effective way.

Not for a long time will there be any decrease in automobile transportation. It is going to increase. It is transportation we are talking about, and the world has never given up a thing of this kind. There have been many statements and loose figures to predict that this year would see a greatly lessened use of cars. The mid-year registration of June 30 shows an increase of something like 17 per cent in the number of cars registered over June 30, a year ago, an increase of some 46,000 vehicles over the registration of December 30. December 30, as you know, is practically the end of the year, when they have driven everybody into registering. In many rural counties the machines are not registered until the crop money comes back. This year any increase of June 30 over December 30 is very definite proof that people are not giving up this means of individual transportation.

DR. HOWE: Mr. John C. Long, Secretary Education Department, National Automobile Chamber of Commerce, New York City. He is especially interested in questions of safety.

MR. LONG: At lunch time someone made the remark that motor vehicles and motor transport had grown so rapidly that the public had not been able to keep pace with them. Perhaps that is best illustrated in the field of accidents on the highways. The accidents, as we know, have been growing steadily every year. One encouraging factor in the situation is that in relation to the number of motor vehicles on highways accidents have been growing less. In

other words, the public has been slowly catching up with the problem in relation to the number of motor vehicles on the road. There has apparently been a gradual improvement in the way of handling the thing, although the grand total of accidents has increased.

This consideration, however, will not be particularly comforting to anyone who may have lost someone in an automobile accident. The automobile industry has been concerned with the problem and is anxious to encourage safety on highways. The majority of accidents occur to children under 15 years of age; a great majority of them occur to pedestrians. The Police Department of New York City claims that 78 per cent were due to the carelessness of pedestrians. That means that a great deal can be accomplished in the way of education.

We asked the help of Commissioner Claxton of this committee in giving suggestions as to what might be done to promote the cause of safety education. Under the direction of the Committee there will be offered, this fall (October, 1921), prizes in all States to the grammar school children for the best essays on how to promote safety on highways.

In that way we hope to bring to the attention of all school children in the country the thought as to how they can conduct themselves on the public highways in order that these may be made more safe. This proposition has been worked out very well in some cities. Detroit, St. Louis and certain other cities carried on campaigns of safety education and have found that such campaigns have definite results in bringing down the number of accidents in the cities. But with the question of teaching the children through these traffic campaigns and these lessons of safety has come the question of what and how to teach them, and we find that the material in that field is very scant. One well-known teacher of safety education said she hardly knew what to teach, as the field was so limited. We have accordingly supplemented the school children prizes with prizes for school teachers for the best lessons on safety education.

Now aside from this class room work there is one other thought which is well illustrated by an incident which I witnessed on 7th Avenue, New York, back of the Metropolitan Opera House. There was a puddle of water and three little children, with long sticks and strings, were seated on a beam, fishing, while taxicabs, automobiles, etc., whirled past. The coming of the automobile has meant that that playground for children, the street, has been taken away. The highway is no longer a safe place for children's play, and along with this safety education should come the promotion of playground work.

The automobile industry and those interested in highways are endeavoring to emphasize the thought that in teaching children to keep off the highways and to be careful in crossing the streets, adequate provision must be made for play. The largest factor in the safety problem is the education of children, and it is our hope and belief that by hammering away at this particular thing, not one year but every year, we shall bring up a generation accustomed to motor transport, who will regulate themselves accordingly.

CHAIRMAN: The next general topic is "Cost Accounting in Highway Transport Operation." The discussion will be opened by Mr. George H. Pride, President of the Heavy Haulage Company, New York City.

MR. PRIDE: The highways and the motor trucks which operate over them together form a plant whose product is transportation. Much public discussion relative to the subject of highways and their construction has occurred in recent years, but comparatively little has been said about their use after they have actually been built.

The public, as a whole, pays for the construction and maintenance of the highways in the form of taxes, and although it is not generally realized, it also defrays the entire cost of the motor truck transportation which passes over the highways, in the price it pays for the commodities it buys, for it can be unqualifiedly stated that practically everything purchased has been transported by motor truck one or more times during its process of fabrication.

Therefore, in order to intelligently approach the subject of highway transportation from the economic standpoint, it is necessary to consider the motor truck operation costs, as well as the costs of constructing the highways.

The relative importance of truck operating costs, as compared with highway construction costs, can perhaps be indicated by the following figures. The last complete figures indicate that for the year 1919 about \$330,000,000 was expended for highway construction. It is reasonable to assume that the yearly expenditures for this purpose in 1920 and 1921 will not greatly exceed this. On January 1, 1921, there were 990,000 motor trucks operating over our highways. It is conservatively estimated that their cost of operation exceeds $3\frac{1}{2}$ billion dollars a year. It can be deduced plainly that the ratio is 11 to 1, that is, that eleven times as much money is spent in operating motor trucks over the highways yearly as is spent in building the highways themselves.

The figure of over $3\frac{1}{2}$ billion dollars a year for the cost of motor truck operation may be received incredulously, but I am prepared to prove that this figure errs from the standpoint of conservatism.

From these figures it must be apparent that, important as is the economics of highway construction, the economics of motor truck operation involves at least eleven times more expenditure, and as the general public defrays both these bills, the economics of highway transportation cannot be intelligently considered unless it embraces both of the foregoing, not only individually but also in the light of their relationship to each other.

A simile which aptly depicts highway transport is a factory, in which the factory building is the highway, and its product highway transportation. If by constructing the building more heavily, or of a more expensive design, it would permit the installation of more efficient machinery, manifestly its product could be manufactured more economically, within reasonable limits. On the other hand, if an unnecessarily high type of building were constructed, which did not permit of the installation of correspondingly efficient machinery, the cost of the product would be unnecessarily high.

It must be plainly apparent, therefore, that the subject of highway transport economics cannot be intelligently dealt with until the costs of highway construction, the costs of motor truck operation, and their relationship to each other are determined with reasonable accuracy.

At the present time there is not available any reliable cost accounting data on truck operation. Some of the truck manufacturers profess to have data, but I have seen little of it which would stand verification. It is easy to see how they may innocently accumulate misleading data, when it is realized that this information is usually secured for the purpose of assisting their sales, and naturally it is an accumulation of maximums instead of averages.

The difficulty of securing this data is still further complicated by the fact that motor trucks have usually been purchased and operated by a class of men whose education and training have been rudimentary, rarely embracing cost accounting. Even in those instances where trucks have been purchased by large corporations, little real care and attention have been devoted to their cost accounting, both because there was little precedent available for the cost department to use in setting up the systems, and also because the trucks were just a comparatively small, annoying detail, not considered as directly productive to the business, and usually under the direction of an ill-paid subordinate, whose mental attainments were not on a parity with other departmental heads, having duties of equal import.

Fortunately, however, there has been developed a system of truck cost accounting which will produce the necessary data, provided a sufficient number of truck operators can be persuaded to truthfully note the comparatively few daily figures this system requires. Once these figures are available in sufficient quantity, reasonably accurate, general average truck operating costs can be determined.

Not only would this data be extremely valuable for the foregoing purpose, but it would be of infinite value to the individual truck operators, because almost invariably the cost of motor truck operation is greatly underestimated. This explains the extremely high percentage of failures among truck operators, and also the reason for so many people entering upon and giving up the business of truck operation each year. There is no industry which compares in magnitude with motor truck operation, where those engaged in it possess so little rudimentary knowledge of its costs.

Even though highway transport has become so firmly knit in the commercial fabric of the country, it must be acknowledged that heavy motor truck line transportation is being done at a needlessly expensive cost.

CHAIRMAN: Mr. J. Rowland Bibbins, Manager, Department of Transportation and Communication, Chamber of Commerce of the United States.

MR. BIBBINS: The subject allotted to me has been very well covered by Mr. Pride and I have little to add. I have drawn off in brief form the attitude of the Chamber of Commerce of the United States on this subject, and I think it would be well for you to know what that attitude is. The Chamber of Com-

merce, of course, makes its statements to the public through the referenda at the annual meetings at which four or five thousand business men are in attendance. The declarations at the last two annual meetings are briefly as follows:

Annual Meeting, 1919

"That highways are an integral part of our nation's system of Transportation has been emphasized by the war, and an enormous development is at hand, so important as to require a comprehensive national policy, under which federal appropriations for highways will be applied to national needs for interstate commerce, agriculture, postal delivery, common defense and general welfare.

"Congress should create a federal highway commission, independent of present departments of the government, composed of members from the different geographical sections of the country, to perform all executive functions of the federal government pertaining to highways, including those relating to existing appropriations in aid of state construction. Such a commission should act in coordination with any federal agency that may have functions in articulating rail, trolley, water and highway transportation.

"Expenditures of funds should be permitted only for highways which are of a permanent type, having thorough drainage, substantial foundations, sufficient width, and a capacity for traffic which will be reasonably adequate for future needs."

Annual Meeting, 1921

"Bonds should be issued by states, territories, counties or municipalities, and federal assistance furnished, only for portions of highway construction which are reasonably enduring and permanent in character.

"Federal appropriations should be made only for assistance to state and territorial highways which will become a part of an interstate system.

"Federal assistance should be continued only to those states and territories which adequately maintain highways for which there has been federal aid.

"Most careful study should be made by the Federal Government in co-operation with state governments as to routes, the probable character of service over such routes, and the best form of construction to meet such service. These studies should include ultimate economies of location and design."

The above declarations were made at the last two annual meetings of the National Chamber of Commerce, which were attended by delegates from the Chamber's membership comprising from 1,400 to 1,500 commercial and trade organizations, 16,000 associate and individual members, and reflecting, directly or indirectly, the views of nearly 1,000,000 business men of America. These conclusions were reached in view of the necessity for a continued and well-defined Highway Policy in the national interest. And in order that funds hereafter spent for highway construction should adequately serve the economic purposes which are just becoming recognized, it was the opinion of these two Conventions that the principles above enunciated should govern.

Certain important points of contact with the expressed purpose of this conference today may be noted:

1. That physical and economic research is definitely favored, not only with respect to adequacy and permanency of construction and capacity for the service to be rendered, but also with due regard to the needs of the future and to economic location, design and operation.

2. That the articulation of various transportation systems, of which highways play an important part, should form one of the very definite purposes of that national agency which is to be clothed with the powers and responsibilities of adequate highway development on a national scale.

These studies and responsibilities are obviously of primary importance and should not be undertaken in a spirit of contention or localism. The National Chamber sincerely believes that the principles it has set forth are fundamental and above local interpretations.

Obviously education must play an important part, and the whole research idea is only one phase of education, viz: to determine the scientific and economic facts. The National Chamber is deeply interested in all worthy educational movements.

If it were possible to stress particular phases of the general topic of the day, there might be mentioned the following:

1. Operating economics.
2. Cost accounting.
3. The public good.

The first two are based upon the conception of Highway Transport as a purely business enterprise, standing squarely on its own feet on a true cost-of-service basis, just as a railroad, steamship, lighting or manufacturing business is conducted. Is it not imperative, first and foremost, to know all of the elements of the cost of highway transport without reservations or distinctions? Only a full scientific cost accounting will reveal the whole facts. I cannot help but think of the excellent systems worked out by the Interstate Commerce Commission and by the State Utility Commissions. A parallelism can very readily be drawn with this new transportation industry. Why do we not start on somewhat the same plan? All of the necessary elements of cost are listed in these standard classifications.

As to the public good, must we not make up our minds, and that promptly, to face the question of public subsidies and call them by their right names? In other words, the national issue ought to be foremost in highways, as it is in shipping and other branches of industry, viz: what part of the service is in the public interest and therefore to be supported by the whole people in the great common interest?

There is one suggestion on the matter of safety. Every driver should be examined every year prior to the granting of a license to prove his or her ability to handle the car. We should not carry insurance to cover all of our carelessness.

CHAIRMAN: Professor J. Gordon McKay of the University of Wisconsin, Economist of the Bureau of Public Roads.

PROFESSOR MCKAY: One of the principal difficulties in the field of highway research is the absence of reliable information on many of the unsolved problems confronting the highway economist and engineer. The rapid growth of road construction and the changing character and volume of the traffic since 1916 are largely responsible for the lack of accurate and extensive information.

Three types of highway cost data are essential: First, studies of construction costs; second, maintenance costs; and third, vehicle operation costs.

A great deal of information is available as to the cost of building the several types of highways. The original cost alone is not the determining factor, but the original cost, compared with the maintenance charge, is one of the determinants in selecting the most economical road type. We must have highway maintenance costs on concrete, macadam, gravel, and dirt roads to intelligently approach the problem of highway valuation. Maintenance studies to be of real value must be continuous over a period of time long enough to offset changes in the price of materials and labor and the change in traffic. A year's study may be of little worth two years later, and it is only through a system of cost keeping, which records construction and maintenance each year, that we can hope to get accurate data.

The third classification of cost information deals with the problem of vehicle operation costs. This is the hardest research problem of the group. The unreliability and scarcity of information make it imperative that extensive vehicle operation cost studies be made by disinterested investigators.

An intelligent approach to the problem of the service value of any given highway requires cost data on construction, maintenance and vehicle operation costs under the same conditions of traffic and on the same road types. While a comparison may be made between the construction cost and the maintenance charges of concrete, macadam, gravel or dirt roads, we cannot arrive at any conclusions as to service value of each type without knowing the saving in vehicle operation costs of the improved over the unimproved road. A comprehensive survey of vehicle operation costs on each of the several road types is necessary before we can make use of construction and maintenance data in the evaluation of a stretch of highway. After all it is not alone the question of original cost and maintenance, but the savings due to improvement in vehicle operation which is one of the principal factors in the justification of the type of construction.

To summarize, research studies must be planned and immediately started to obtain construction, maintenance and vehicle operation costs on the several types of highways before even an approximation of the service value of a highway can be made.

CHAIRMAN: "National and State Legislation" will next be discussed by Mr. A. N. Johnson, Dean of Engineering, University of Maryland.

DEAN JOHNSON: The question of highway legislation I shall attempt to discuss purely from a university and academic side, the educational phase of it. The highway engineers are the ones who operate under the highway laws, and,

in the majority of instances, probably the first ones to realize where a particular law is a misfit, where it could have been changed to advantage, to offer a chance for better methods of handling the work and with more satisfaction to the public. It seems to me, therefore, that it is essential to include in the studies that an engineer should have, if he expects to get into highway work, the elements, at least, of legislation, particularly highway legislation. The average engineering student is appalled usually when he has to interpret or to read a statute. That is something quite foreign to him. The mere reading of the laws, with understanding, would in itself furnish a great deal of valuable instruction in highway legislation. It could well be carried further and amplified by studying highway legislation in a way similar to the study of specifications, for, after all, the legislation is but a step from the specification. Specifications must be drawn within the limitations of the laws under which the work is to be done. And there is no reason why the student who later may operate under these laws should not be made familiar with the law itself and be able intelligently to draw up and prepare a bill in such form that he can operate under it efficiently. Yet, there are few engineering students that have received preparation along this line. I think, like myself, most of the engineers in highway work who have had to do this have been thrown up against it and have groped in the dark. It is the hardest and most expensive way possible to educate themselves; whereas a little guidance in their student years would have saved them an immense amount of hard work and a good many regrets.

In the study of Highway Legislation, there is first required an analysis or outline of what the subject comprises. Such an outline is presented, which represents the result in part of an exhaustive study of the statutes of each state. This outline was prepared to show a logical sequence of the subjects found in legislation:

GENERAL OUTLINE OF HIGHWAY LEGISLATION

Article I—General Clauses

1. Short Title.
2. Definitions.
3. Classification.

Article II—Establishment of Highways

1. By Adoption.
2. By Creation.

Article III—Control of Highways (By the Public)

1. *Organization and Administration*—
 - A. State Highway Control.
 - (a) State Highway Department:
Establishment.

(b) State Highway Commission:

- How Appointed.
- Qualifications.
- Tenure of Office.
- Removal.
- Salary.
- Powers and Duties.

(c) State Highway Engineer:

- How Appointed.
- Qualifications.
- Tenure of Office.
- Removal.
- Salary.
- Powers and Duties.

(d) Other Employees:

- Under Control of State Highway Engineer.
- Civil Service Requirements.

B. County Highway Control.

(a) County Boards:

- Powers and Duties (relating to highways).

(b) County Highway Engineer:

- How Appointed.
- Qualifications.
- Tenure of Office.
- Removal.
- Salary.
- Powers and Duties.

(c) Other Employees:

- Under Control of County Highway Engineer
- Civil Service Requirements.

C. Town or Township Highway Control.

(a) Township Board:

- Powers and Duties (relating to highways).

(b) Township Highway Superintendent:

- How Appointed.
- Qualifications.
- Tenure of Office.
- Removal.
- Salary.
- Powers and Duties.

(c) Other Employees:

- Under Control of Township Highway Superintendent.
- Civil Service Requirements.

2. *Road Work*—

A. State:

- (a) State Highway System (How Established or Defined).
- (b) Procedure Preliminary to Construction.
- (c) Provisions Controlling Construction:
 - Procedure for Letting Contracts.
 - Payments, Bonds Required.
 - Day Labor Work Permitted
- (d) Maintenance.
- (e) Funds.

B. County:

- (a) General Road Work.
- (b) Special Road Work.
- (c) Funds.

C. Township:

- (a) General Road Work.
- (b) Special Road Work.
- (c) Funds.

D. Special Highway Improvement Districts:

- (a) Preliminary Procedure to Establish.
- (b) Construction.
- (c) Maintenance.
- (d) Funds.

3. *Bridge Work*—

A. State:

- (a) Procedure Preliminary to Construction.
- (b) Construction.
- (c) Funds.

B. County:

- (a) Procedure Preliminary to Construction.
- (b) Construction.
- (c) Funds.

C. Township:

- (a) Procedure Preliminary to Construction.
- (b) Construction.
- (c) Funds.

4. *General Labor and Contract Provisions*—

- (a) Free Labor.
- (b) Convict Labor.
- (c) Contracts.

Article IV—Control of Highways (By Toll Companies)

1. *Toll Roads, Toll Bridges, Toll Ferries.*

- A.* How Established.
- B.* Duties of Owners.
- C.* Rates of Toll—How Regulated.
- D.* Supervision and Control by Public Officers.
- E.* How Abandoned.

Article V—Use of Highways

1. *By General Public—*

- A.* Traffic Regulations:
 - 1. Law of the Road.
 - 2. Speed.
 - 3. Load Limitations.
 - 4. Vehicle Licenses and Regulations.
 - (a) Motor Vehicles.
 - (b) Traction Engines.
 - (c) Other Vehicles.

B. Offenses and Penalties:

- 1. Obstruction in Highways.
- 2. Injuries to Highways.

C. Damages Sustained by Persons.

2. *By Abutting Owners—*

- A.* Privileges Along the Road:
 - 1. Entrances.
 - 2. Sidewalks.
 - 3. Trees and Hedges.
 - 4. Water Troughs
 - 5. Advertising Signs.
 - 6. Itinerants Camping

B. Privileges Across the Road:

- 1. Gates Across Road.
- 2. Cattle Passes.

3. *By Corporations and Utilities—*

- (a) Railroads.
- (b) Poles for Electric Wires.
- (c) Pipes and Conduits.
- (d) Canal and Irrigation Ditch Crossings.
- (e) Mining Operations Under Highway.

Article VI—Saving and Repeal Provisions

The foregoing would be the undergraduate phase of highway legislation. There is a very wide field open in graduate work. I should say, however, that

it is more for students other than engineering students. For example, there could be a comprehensive collection of the highway laws of the states, arranged to bring out certain features or laws bearing on a certain phase of highway work that could be compared as they exist in the various States. Many of you are familiar with the very interesting little book, "The King's Highway," by Sydney and Beatrice Webb, where a great deal of material has been gotten from the old English laws governing highways. One of the most interesting chapters in the first report on Maryland highways was that on the history of the old roads chiefly gleaned from the old Colonial acts and the earlier acts of the Maryland legislature, bringing out in a most interesting manner the development of the highways and the highway systems. That was written as a thesis for the doctor's degree in history, and while these may not, perhaps, be topics for the engineering students, they offer a wide field for graduate work in other than engineering lines.

CHAIRMAN: Our next talk will be by Mr. William A. Bassett, Chief of the Engineering Division of the National Institute of Public Administration, New York.

MR. BASSETT: Our organization has been established for the purpose of carrying on educational work in the field of public administration. For the past ten or fifteen years its predecessor, the New York Bureau of Municipal Research, carried on advisory service to various governmental units throughout this country in matters of municipal administration. One result of that work was to show the need for educating not alone the official identified with public administration but most of all the public, and in recognition of that need our present institution was established this year.

There are three phases to the work in which we are engaged. The first phase is education of the individual. This phase preferably should come within the scope of existing educational institutions. We have had it forced upon us to a certain extent on account of the demand for men in public service, city managers for instance, and in allied fields such as secretaries of chambers of commerce, individuals who are not dealing with the technique of professional work but the technique of government. Sometime ago I communicated with Professor Tilden on this matter, the idea being that possibly some work in highway administration might be started. I was not aware at the time of the character of work being done by this committee, although in a general way I knew what was being done in highway education by educational institutions throughout the country. This knowledge led me to believe that they were not meeting the need for training in highway administration. This applies particularly, as brought out by Dean Johnson, to the consideration of matters relating to legislation and the effect of ill-advised legislation on highway work. Recognizing what is being done by the committee on highway and highway transport education, and the other representatives attending this conference, I would like to state that our organization is ready to cooperate in any way for furthering this work. Professor Hatt outlined its scope most clearly and

also emphasized the necessity for coordination in the field of research. The value of that is obvious, and we wish to feel that possibly we may be an aid in furthering educational work in highway administration.

DR. HOWE: Mr. Roy D. Chapin, President of the Hudson Motor Car Company of Detroit.

MR. CHAPIN: I am going to confine myself absolutely to the question of national highway legislation.

Out of this meeting as much as any meeting I have ever attended has come a demonstration of the fact that there are many problems that cannot be treated from a state or local standpoint but must be treated nationally. Is it a proper function for the Federal Government to study these problems? We have, as has been pointed out, an economic interest in the use of the highway which, so far as the billions of dollars are concerned, is much more important than the actual cost of the highways. The time has come when the economic interest of each state, each community and the nation in the subject of roads far transcends the mere problem of construction and maintenance.

The President yesterday in his message to Congress devoted a great deal of attention to the situation of the railroads, realizing that the prosperity of this country—and we are all concerned in this—is vitally tied up in the prosperity of the railroads. It is time this nation assumed its own responsibility in connection with the prosperity of highways and highway transport. The annual cost of operation of motor vehicles today is certainly between four and six billion dollars, an amount probably equal to the annual expenditure for railroad transportation. That, as you can see, is considerably in excess of the amount spent for building highways. Registration of motor vehicles is at present around ten million. The tendency over the next five years in the cost of motor vehicles, both passenger and truck, is going to be lower. That being so, you are going to have, not a registration of ten million, but a registration by 1925 of fifteen million or possibly more, a 50 per cent increase in the use of our highways. That, I submit to you, is a problem of vital concern to the United States Government because no state can regulate, can investigate and can serve this country as a state except as it functions with the Government in this tremendous problem.

Our governmental legislation from an administrative standpoint should recognize this tremendous change that has taken place over the last five or ten years, and the fact that no longer is this a purely engineering problem. The Government today has the responsibility to help research work on highways and highway transport throughout this country, to help coordinate it. The Government should be the central tying-in place because the Government has funds to spend. It is responsible through these funds to each taxpayer in the country. We have as yet a very poorly connected system of highways. France has set a pace for us. It doesn't make any difference whether it is a highway or a dirt road, you drive on a good road anywhere in France. That time is coming in this country and coming fast. The billions of dollars we are spending on high-

ways will create a similar condition here. The Government has a great responsibility in directing the expenditure of these funds. Certainly a central authority in Washington, in touch with every state and every unit, is going to help.

The relation of the rail and the waterway to the highway have never been set out satisfactorily, and it is going to take time to do it. Uniform laws are of the utmost importance. We go from state to state with different regulatory laws. Two licenses are required to operate between Maryland and the District of Columbia. The question of safety, of saving human lives, which has been brought out so well today, is one in which the Government is particularly interested.

The time has come when federal legislation must be passed which will recognize the importance of highways and highway transport and the responsibility that this Government has to the people. The time has come when we must look at this question not purely from the standpoint of locality, not from the standpoint of building of roads, but from the standpoint of transportation.

CHAIRMAN: We have listened to a number of very important and interesting papers and now the question comes: What is the next step? It has been suggested that we try to determine the most important things in this matter of highways and highway transport so that this information may be available for the committee which called this meeting and for other committees working in the same field. I am going to ask Mr. A. M. Loomis, of the National Grange, to say a few words on this question.

MR. LOOMIS: There is one thing which seems to me of some importance. I believe it hooks up particularly with the research work to be done in the field of economics dealing with financing highway construction. The farmers of the country are in some ways the people most intimately connected with the highway problem, and of those farmers and their families there are some 35,000,000, about a third of the population of the country. It forms a large block, and to get legislation you have to have votes. That is one of the basic things we learn in Washington. There has been a great misapprehension in the minds of the people who have been earnestly and sincerely back of the good roads movement, as to the influence and effect of that movement on farms and farmers. It has been largely due to errors of economic thinking.

For instance, my grandfather's farm is still in the family in western New York, and recently a good road has been built by that place. It has not increased the value of the farm or the productivity, nor has it made any material economic change in the condition of the man on that farm. That is rather a broad statement; perhaps I am putting too much emphasis on it, but in general that is the state of mind of the farmer toward the good road. He wants to be shown what he is going to get out of it. That leads to the economic question involved, the question of financing, of how the money is to be raised and where it is to come from. The economies of good roads, hard surfaced highways and cheaper transportation is the economy in the final marketing price. The place

where the farmer benefits from the good roads, excepting in imponderables, is chiefly in that which he hauls to his farm over the road instead of that hauled from the farm to the market. And that is not a very big item in his year's business. I haven't a great deal of reliance in my mind on the farm-to-market highway. I don't believe much in that phrase or what it means. The consumer is interested in that, but not the farmer. There is a great deal of misthinking and misunderstanding and misapprehension about all those things.

The money which must be raised for highway construction must be apportioned as nearly as is humanly possible so that the cost of improvement is assessed in proportion to benefits derived, and that, I am afraid, has not been very largely the state of legislation enacted in the past, and that is the reason for the farmer's present state of mind. The great authorities point out convincingly the burden of taxation that rests on farm property. That is due to the fact that the farmer's property is easily seen and easily taxed. Burdens of taxation are rather leaned over on the farmer, and the high costs of highway building, owing to this situation, have been naturally divided in that way. If there is one single reason, that is why the National Grange was friendly to the original Townsend Bill for construction of a national system at national expense. That is a way to build highways which fairly and equitably divides cost of improvement in proportion to benefits derived.

The time for general discussion was limited, but following are the more important points which were brought out.

DEAN JOHNSON: I think we have been impressed by the fact brought out by several speakers as to lack of certain data relating to elemental costs of highway transportation. We cannot have such data without first answering the question: What is highway transportation? In other words, one of the most important topics for immediate study is the traffic census. Find out how much we are using our roads, how and where we are using them. We must develop as soon as possible a method of taking traffic census that will give us these data and have them actually gathered. A little study shows how meager existing traffic data are. Now and then a State takes a census during one day. There is a traffic map of New York State taken one day during August, and that is immensely valuable in showing what we haven't got. We must know the fundamental facts of how much we use our roads before we can make any estimate as to the value we are getting from them.

PROFESSOR HATT: From the standpoint of research I am especially interested in education. I hope this committee will not cease its endeavors before it accomplishes what seems to me an important part of its work, namely, suggestions to colleges as to what they might do in the study of highway economics. Professors of economics are perhaps not interested; they do not see the importance of it. Their students study money and banking and things of that kind, but there are few courses in transportation. The real need just now seems to be to impress teachers of economics with the live need for constructive

thinking along these lines. They cannot do effective teaching until they get the necessary data and the whole problem before them.

MR. PRIDE: I recommend that we determine upon one of the present methods of cost accounting, give it our approval, send it to various colleges that have economics departments and that might be interested in securing data based on that plan, asking them to transmit the results they secure to us. That will allow us to collate it in one final total.

MR. BIBBINS: I would reiterate the relation of the highways to other methods of transportation. The attempt to define the coordination of various transportation facilities is an attempt to get light upon what we mean by the public good with reference to highway transport—that is, an allocation of the ultimate burden.

DR. WALTON C. JOHN, U. S. Bureau of Education: I might call attention to the possibility of making a study of safety and safety teaching in the public schools through the Bureau of Education and the Highway and Highway Transport Education Committee. A preliminary investigation indicates that there are valuable data in many of the leading schools which would furnish useful material for those who are interested in propaganda regarding safety work. We can save 25,000 lives a year by putting into general operation what Detroit is doing.

PROFESSOR TILDEN: The discussion here today will be of value to the committee in making concrete suggestions for the development of educational work. There have also been suggested a number of topics for research.

In colleges and universities we have two distinct groups. There is the undergraduate—that is, the high school boy who in four years is to be given some idea of his responsibility as a productive citizen and headed in the direction of useful work. Then there is the graduate student, whose chief interest is research. For the first group we need carefully organized courses of study, planned especially to stimulate the imagination and develop intellectual power. Not long ago I asked one of the leading economists in this country, a professor at a large eastern university, why the university had no courses in highway economics. His reply was that it would take five years to so coordinate and correlate even the facts that we already know about highway economics that they might profitably be presented to an undergraduate body. It seems a needlessly pessimistic view to take. Think of the additional material that will accumulate in the next five years!

The outline of the field of highway research which Dr. Hatt has given us is most suggestive and stimulating. From it many topics may be chosen for graduate study and investigation, for students working either singly or in groups, or for more mature investigators in engineering and economics.

MR. CHAPIN: It is fitting that before we leave today a vote of thanks be extended to the University of Maryland, to President Woods and to Dean Johnson for their great hospitality to the conference.

The motion was passed by a rising vote, after which the chairman declared the meeting adjourned.

Mr. H. G. McGee, Bureau of Municipal Research, Akron, Ohio (by letter, after the conference): The thing we all need and are groping for in different ways is a consolidated financial statement of this business of highway transport. Most of our suggestions and figures have centered about individual elements in this business, of how to arrive at costs, of safety, of financing. Each is significant and essential. But we need to see the whole, the woods as well as the trees.

With such a consolidated statement it seems to me that many of our perplexing and disputed questions of policy may answer themselves almost automatically. Suppose we attempt to set up a statement for one division of this highway transport business, that of highway improvement. Our balance sheet might look something like this:

Assets and Liabilities of Improvement as of 192

ASSETS

1. Investment in construction of improvement.....	\$.....
2. a. Benefits to suburban traffic.....	.....
Less road payments by suburban traffic.....	.....
Net benefits to suburban traffic.....	.....
b. Benefits to farms.....	.....
Less road assessments and additional taxes.....	.....
Net benefits to farms.....	.....
c. Benefits to through and other traffic.....	.....
Less general property taxation, tolls, etc.....	.....
Net community benefit.....	.....
Net benefit of improvement.....	.....
3. Cash and other resources.....	.....
4. Total assets.....	.....

LIABILITIES

1. Bonds outstanding.....	\$.....
2. Depreciation reserve.....	.....
3. Deferred maintenance.....	.....
4. Proprietorship (investment from income).....	.....
5. Surplus.....	.....
6. Total liabilities, proprietorship and surplus.....	.....

Such an application of the standard business test would give a statement of the real status of a road improvement at any particular time. But we will also be interested in discovering how we arrived at the particular position indicated by the balance sheet. This may be determined from an annual operating statement which might look something like this:

Profit and Loss on Improvement for Year Ending 192-

REVENUES

Sales (Cost of equivalent transportation services over unimproved highways or by other agencies, as rail or water, minus cost of actual transportation services over improvement).

a. Benefit to suburban traffic.....	\$-----
b. Benefit to farm traffic.....	-----
1. Hauling.....	-----
2. Social.....	-----
c. Benefit to intercity traffic.....	-----
d. Increased taxes from increased valuations.....	-----

Total Services rendered.....

EXPENSES

Interest on construction cost.....

Administration.....

Maintenance.....

Depreciation.....

Service profit.....

Total expense and profit.....

Both these statements seem to me fundamental. Revenues and expense may be capitalized and transferred to the balance sheet; but if we distinguish between balance sheet and operating accounts we greatly lessen the chances of adding together all debits, assets and expense items, and comparing the total with all credits, liability and revenue items, a process which gives us exactly nothing at all, literally and figuratively. Some of these items ought to be determined without great difficulty from existing records. For example, the road improvement investment and outstanding bond obligations appearing on the balance sheet; interest, appearing on each annual operating statement.

But most businesses judge progress by sales. Sales, or services rendered, is not provided for in any highway accounting system so far as I know. They comprise two factors: number of transactions and amount of each. Maryland's rebuilding of the Baltimore-Washington road for \$600,000 was based on 12 one-day traffic counts taken one month apart. Unquestionably this rebuilding was a profitable investment. But try to imagine, if you please, just how far

any commercial business would get if it were to be guided only by 12 one-day counts a year of the number of transactions it made.

For these reasons, I am heartily in accord with Dean Johnson's insistence that the fundamental thing to be determined is the volume and value of traffic. Without it, the real service value of our highways can be only a poor guess.

These setups are not intended as dogmatic; they are intended to suggest that the application of the standard business tool for determining the success of an enterprise, be it selling newspapers or running railroads, may be the best tool with which to correlate significant facts to guide towards a successful highway policy.

How does this apply to highway and highway transport education? The ability to use and the intelligence to demand standard business practice ought to be a part of the undergraduate education, not only of the engineer who is to go out to help design, build and operate highways, but of every college man who may be connected with any of our public or private enterprises. As a recent editorial in the *Engineering News-Record* stated, successful enterprises depend upon a profit either to the investors in cash, if it be a commercial enterprise, or to the public in service, if it be a public enterprise.

What do students know about this matter of financial statements?

If a personal experience will be pardoned, I want to cite two incidents which lead me to suspect that these standard methods of determining profits in cash or benefits are not usually familiar to college-trained engineers. In my own case, at the time of leaving college, all I knew about a balance sheet was that it was something bankers printed on page three of the newspapers every six months in conformity with law. Financial statements were not mentioned in our course of study. I had been out of college several years before I discovered the distinction between a balance sheet and an operating statement, and their importance.

Further, a little less than a year ago, I became a member of the governing board of a local engineering society. This organization found itself with very small cash resources and eight months' operation to finance before additional dues would be payable. With the help of an accountant, its records were transformed from a single entry cash book system to a double entry set of accounts. It took three months of repeated offering of a balance sheet and operating statement to the directors, among whom were included two chief engineers and others in responsible engineering positions, before they appreciated the significance of the financial statements. When, however, they were educated, knew what to look for, what action the accounts indicated, and then took such action, the society commenced to better its financial position and actually closed the fiscal year ending May 31, 1921, in better shape financially than it had closed the apparently very prosperous year preceding.

These experiences have led me to suspect that engineers have not been trained to appreciate this business tool, which allows them to see any enterprise as a whole, be it highways, water works, power plant, railroad or newsstand.

As I see it, cost accounting is simply the application of a financial statement to a single unit or unit operation of the multitudes which may go to make up a complete enterprise. Fundamentally, its principles are those which lead to general financial statements. It would be my suggestion, then, that a comparatively small amount of time, say in the senior year of engineering courses, be given to the illustration of and the use of financial statements as the criterion of success or failure of enterprises.

Such a study might be included in some general policy lecture courses. It might, as in our own case in Akron, start with an illustration applied to some local or student activity and be broadened by bringing in a few statements from great businesses like the railroads. It is not suggested that engineers should become expert accountants. It is suggested that they shall appreciate and be able to use the fundamental results of an accountant's work, to be able to apply them to each enterprise with which they are connected, and to gain thereby an outlook which will enable them to coordinate and appreciate, in their respective phases, each of the elements which go to make up a successful enterprise, be it highways, highway transport, or what not. An increasing number of men and women who learn to ask for and to use intelligent and intelligible statements of the how and why of our public and private enterprises will advance the cause of successful highways and other successful enterprises, both public and private, far more rapidly than any undergraduate study of detailed problems.

Those Attending the Conference

(Arranged in Alphabetical Order)

E. J. ADAMS, Eugene, Oregon.
T. W. ALLEN, General Inspector, Bureau of Public Roads, Washington, D. C.
W. A. BASSETT, Chief of Engineering Division, National Institute of Public Administration, New York, N. Y.
W. T. BAWDEN, Assistant to the Commissioner, Bureau of Education, Washington, D. C.
F. S. BESSON, Major, Corps of Engineers, U. S. Army, Washington, D. C.
J. R. BIBBINS, Manager, Department of Transportation and Communication, U. S. Chamber of Commerce, Washington, D. C.
J. W. BROOKS, Director, American Highway Educational Bureau, Washington, D. C.
A. J. BROSSEAU, President, International Motors Company, New York, N. Y.
R. D. CHAPIN, President, Hudson Motor Car Company, Detroit, Mich.
P. P. CLAXTON, Formerly U. S. Commissioner of Education, Provost-Elect, University of Alabama, University, Alabama.
H. G. COLLINS, The White Company, Cleveland; Ohio.
C. D. CURTISS, Assistant to the Chief, Bureau of Public Roads, Washington, D. C.
N. W. DOUGHERTY, Professor of Civil Engineering, University of Tennessee, Knoxville, Tenn.
M. O. ELDREDGE, Director of Roads, American Automobile Association, Washington, D. C.
L. M. ESTABROOK, Associate Chief, Bureau of Markets and Crop Estimates, Department of Agriculture, Washington, D. C.
F. W. FENNER, General Motors Company, New York, N. Y.
W. K. HATT, Professor of Civil Engineering, Purdue University; Director, Highway Research, National Research Council, Washington, D. C.
R. A. HAUER, International Motors Company, New York, N. Y.
CHARLES S. HOWE, President, Case School of Applied Science, Cleveland, Ohio; Chairman of the Conference.
CLYDE JENNINGS, Managing Editor, "Automotive Industries," New York, N. Y.
W. C. JOHN, United States Bureau of Education, Washington, D. C.
A. N. JOHNSON, Dean, College of Engineering, University of Maryland, College Park, Md.
PYKE JOHNSON, National Automobile Chamber of Commerce, Washington, D. C.
J. C. LONG, Educational Secretary, National Automobile Chamber of Commerce, New York, N. Y.
A. M. LOOMIS, National Grange, Washington, D. C.

T. H. MACDONALD, Chief of the Bureau of Public Roads, Washington, D. C.

J. N. MACKALL, Chairman, Maryland State Roads Commission, Baltimore, Maryland.

J. C. MARQUIS, Editor, "Country Gentleman," Philadelphia, Pa.

W. E. McCOMAS, Portland Cement Association, Washington, D. C.

H. G. McGEE, Assistant Director, Bureau of Municipal Research, Akron, Ohio.

J. G. MCKAY, Professor of Economics, University of Wisconsin, Madison, Wisconsin; Economist, Bureau of Public Roads.

GEORGE H. PRIDE, President, Heavy Haulage Company, New York, N. Y.

CHARLES L. RAPER, Dean, College of Business Administration, Syracuse University, Syracuse, N. Y.

GEORGE A. RICKER, District Engineer, Portland Cement Association, Washington, D. C.

S. S. STEINBERG, Professor of Civil Engineering, University of Maryland, College Park, Md.

E. G. SUTTON, Executive Secretary, National Association of Sand and Gravel Producers, Washington, D. C.

C. J. TILDEN, Director, Highway and Highway Transport Education Committee, Washington, D. C.

A. F. Woods, President, University of Maryland, College Park, Md.

GEORGE F. ZOOK, Chief, Division of Higher Education, Bureau of Education, Washington, D. C.

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